UNITED
NATIONS

E

Economic and Social Council

Distr.
GENERAL

E/C.7/1991/8
13 February 1991

ORIGINAL: ENGLISH

COMMITTEE ON NATURAL RESOURCES
Twelfth session
25 March-4 April 1991
Item 4 of the provisional agenda*

WATER RESOURCES: PROGRESS IN THE IMPLEMENTATION OF THE MAR DEL PLATA ACTION PLAN

Strategies and measures for the implementation of the Mar del Plata Action Plan in the 1990s

Report of the Secretary-General

SUMMARY

The present report formulates proposals for a strategy to accelerate implementation of the Mar del Plata Action Plan in the 1990s, in accordance with Economic and Social Council resolutions 1987/7 and 1989/7. After a brief general overview of progress achieved and problems encountered to date, critical issues are identified, which call for greater emphasis in the coming years if the targets for water-related development are to be attained and, more particularly, if the land and water resource base, necessary for sustained development and production, is to be preserved. The report indicates those political, institutional, economic and social aspects calling for early and urgent action in national programmes associated with water development and management, within a strategy for the 1990s, and offers for discussion a possible model to enable the international community to play a more effective part in assisting in the sustainable management of the world's water resources.

Full information and detailed recommendations are provided in the background papers that have been prepared for specific sectors and issues as part of the process of formulating the proposals contained in this report.

* E/C.7/1991/1.

READEX FICHE

CONTENTS

	Paragraphs	Page
INTRODUCTION	1 - 5	3
I. GENERAL OVERVIEW OF PROGRESS AND PROBLEMS IN THE IMPLEMENTATION OF THE MAR DEL PLATA ACTION PLAN	6 - 12	4
II. CRITICAL ISSUES FOR ACTION IN THE 1990s	13 - 71	5
A. Land, water and population	13 - 19	5
B. Water resources assessment	20 - 26	7
C. Drinking water supply and sanitation	27 - 29	9
D. Water for agriculture	30 - 51	10
1. Water use efficiency	35 - 38	11
2. Waterlogging, salinity and drainage	39	11
3. Water quality management	40 - 44	12
4. Small-scale water programmes	45 - 47	13
5. Scarce water resources management	48 - 51	13
E. Water quality	52 - 57	14
F. Water management and legislation	58 - 66	16
G. Shared water resources	67 - 71	18
III. A STRATEGY FOR THE 1990s	72 - 99	19
A. Action at the national level	73 - 93	19
1. Water resources assessment	73 - 75	19
2. Drinking water supply and sanitation	76 - 78	20
3. Water and sustainable agricultural development	79 - 81	22
4. Water quality	82 - 85	23
5. Water and related human resources management	86 - 93	24
B. International support	94 - 99	26

INTRODUCTION

1. The present report is submitted to the Committee on Natural Resources in accordance with Economic and Social Council resolutions 1987/7 and 1989/7, by which the Secretary-General, in consultation with the regional commissions and organizations of the United Nations system, was requested to formulate proposals for a comprehensive strategy for the implementation of the Mar del Plata Action Plan during the 1990s, and to submit those proposals to the Committee at its twelfth session.

2. As a basis for the formulation of those proposals, regional assessments of progress and issues concerning key aspects of the Mar del Plata Action Plan were carried out with the support of the United Nations Development Programme (UNDP) and in cooperation with the regional commissions, the Department of Technical Cooperation for Development of the United Nations Secretariat, the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Health Organization (WHO) and the World Meteorological Organization (WMO), and in consultation with other organizations concerned. The regional assessments dealt with issues related to water resources assessment, water for agriculture, water quality, water resources management, and human resources development. The results of those assessments were utilized for the formulation of action proposals at the regional and global levels, and reviewed by the Intersecretariat Group for Water Resources of the Administrative Committee on Coordination (ACC) at its eleventh session. Full information and detailed recommendations are provided in the background papers that have been prepared for specific sectors and issues and which are available to the Committee for consultation.

3. The United Nations Water Conference, in 1977, emphasized that the task was to adopt policies for the further development and efficient utilization of water, with the basic objective of promoting the level of preparedness needed to avoid a water crisis of global dimensions within the next few decades. Since the Earth's water supply could not indefinitely withstand man's accelerating demand for water, and given the additional problems of pollution from man's activities, water management had become a central consideration.

4. The main objective of the Conference was to devise adequate ways and means to meet social demands for water, taking into account the fact that the resource itself was quantitatively fixed and that its management must be controlled in such a way as to accommodate the long-term demands imposed by the world growth of population, agriculture and industry. 1/

5. In this final decade of the twentieth century, world, regional and national objectives of improved quality of life, relief of poverty and hunger and conservation of the environment remain the same as in the 1970s, and are now even more clearly focused. But, for many, there has been a further deterioration of these conditions, often clearly linked with failures in programmes for water-associated development and management. Now, in the face of even greater

urgency to solve human and natural resources problems, including possible global climate changes and their probable consequences on water resources, measures must be formulated that will be far more effective than in the past.

I. GENERAL OVERVIEW OF PROGRESS AND PROBLEMS IN THE IMPLEMENTATION OF THE MAR DEL PLATA ACTION PLAN

6. Most sectors in most regions can point to impressive progress since 1977. As an example, during the International Drinking Water Supply and Sanitation Decade, new and improved water supplies will have been provided to over 1.3 billion people, with more than 740 million having improved sanitation in the developing countries. Even so, out of a total population of 5 billion in those countries, it is expected that the end of the Decade will still leave 1.2 billion needing a safe water supply and 1.7 billion lacking sanitation. 2/

7. In countries where scarcity of water and competition for its use have brought recognition of its true value, industry has been forced to adopt conservation practices, such as recycling of cooling and process water. Where strong environmental awareness exists, and where water quality is at last seen also as a criterion of availability for the majority of uses, an improved level of pollution control is becoming evident. However, in many developing countries now embarking on industrialization, such concerns are usually subordinated to urgent needs for production.

8. Agriculture has made some remarkable achievements in productivity through the expansion and intensification of irrigation, in the arid regions such as Western Asia, with the development of previously unused resources, and in the Asia/Pacific region where limits on available land have required changes in production technology. But expansion in the arid lands has often been through the overdraft of groundwater, the use of fossil groundwaters or brackish waters, or the reuse of waste waters, posing a risk of contamination of soils and water sources. In the Asia/Pacific region, the rate of increase of crop production is now declining, as practical limits of technology are reached, again to the detriment of land and water resources. Population growth and the accompanying demand for food are thus exceeding the level of sustainability of the irrigated lands under present techniques and efficiency levels in water management.

9. The interrelationships between land management and hydrological regimes were well recognized at the United Nations Water Conference. But since then, changes in land use in all regions of the world have provided dramatic evidence of the rapidity and severity of the effects of inappropriate treatment of the land. Deforestation has created widespread problems, with resultant degraded land, soil loss, sedimentation and induced flooding and waterlogging.

10. While these issues are apparent, there is minimum effort to monitor their effects systematically in order to assess impacts and costs, and to chart progress so as to devise and implement measures for their correction, or at least containment. In fact, the assessment of hydrological resources - surface and groundwaters, quantity and quality - and changes in these parameters, has been one

of the casualties of stagnating or declining economies in many of the developing countries.

11. The Mar del Plata Action Plan was intended as a basic policy framework for the development, utilization, management and protection of water resources. The International Drinking Water Supply and Sanitation Decade, which has been closely supportive of national strategies for the sector, is probably the one area where the Conference resulted in major practical interventions beyond the scope of normal existing assistance programmes. At the same time, the Action Plan did identify a range of issues calling for attention and for the allocation and deployment of national and international resources, to forestall crises of water shortage, pollution and environmental damage.

12. For a variety of reasons, including wars, civil disturbances, droughts and famines, debt burdens and economic recession, the majority of developing countries have been unable to devote sufficient resources to programmes for water resources development and management to prevent some further decline in the situation already causing concern in 1977. In recent years, there have also been severe constraints in assistance from external support agencies. However, there has been a general growing awareness of the impact of population growth, and consequent land and water utilization, on both water quantity and quality, and thus on its availability for intended future use. Focusing this awareness more clearly on some specific and increasingly urgent issues provides an opportunity to restimulate world interest in critical aspects of water management and to encourage the mobilization of support necessary for a strategy and related action programmes for the 1990s and beyond.

II. CRITICAL ISSUES FOR ACTION IN THE 1990s

A. Land, water and population

13. The World Commission on Environment and Development noted that global water use, which doubled between 1940 and 1980, would redouble by the year 2000. Some 80 countries, with 40 per cent of the world population, already suffer from serious water shortages. 3/ By the year 2000, the world population will have risen from the present 5.2 billion to exceed 6 billion, and will continue to rise, although at a reduced rate. This growing pressure of population on the limited resources of water and land is central to the need for a future strategy that will resolve the competition and conflict among various use sectors, and among the riparians of national and international waters, in support of sustainable development.

14. Recognition of the close linkages between land management and the status of water resources is also essential. The population-supporting capacity of land is largely dependent on the degree of water management for the production of staple crops, which is the main form of water consumption in the majority of countries, even those mostly dependent on rainfed cultivation, and a primary factor where irrigation is widely practised. In Egypt, some 88 per cent of gross available water resources is applied to irrigation, 4/ while in the United States of America, about 40 per cent of the water withdrawn and 80 per cent of the water consumed is for irrigation. 5/

15. The impact of planned, intensified agricultural production through increased water use is an obvious example of land/water relationships. The more subtle, usually unplanned forms of changed land use, such as those accompanying the needs of growing rural populations for new arable land, may be even more dramatic in their long-term effects on hydrological regimes, and on water quality, where management of the land is unsuited to its productivity limitations in the forms of slope, cover and soil fertility.

16. The rapid growth of urban centres in many developing countries has brought in its wake a host of serious environmental problems. These are particularly serious in the case of water resources because of the concomitant increases in demand and the degradation of water quality owing to problems of waste disposal and salinity intrusion. The availability of safe water in urban centres is fast becoming one of the most important factors limiting socio-economic development, and a crucial indicator of the quality of life in the urban environment. The rapid growth of urban centres also brings with it a general demand for more food production, with implications for intensified cropping. This urban growth, although tending to decrease the proportion of rural populations, does not usually reduce the absolute numbers of rural dwellers, but merely slows the rate of increase.

17. The semi-arid regions are most vulnerable to water scarcity constraints, not simply because of low annual or seasonal rainfall, but because it is in these regions that fluctuations in precipitation are greatest. It is claimed that many of the development problems in such regions have their origin in heavily sectoralized policies of bilateral and multilateral agencies, intended to improve human health, increase food production, reduce famine and poverty, and generate foreign exchange by developing natural resources, including the growing of crops for cash or export. The focus on development has ignored the significance of natural resources limitations and of climate, giving rise to failures blamed, sometimes wrongly, on "drought" and "desertification". 6/

18. Recent recurrent droughts and declining water availability have demonstrated the need for greater attention to overall land and water management practices in the more arid parts of the Asia/Pacific region. This has involved studies into the improved efficiency of water use, especially in irrigated and rainfed farming. The concept of "drought-proofing", reflecting concerns about possible climatic changes, has been adopted in India and China, which are encouraging conservation measures such as minor water storage, groundwater recharge, water harvesting, improved soil moisture practices and associated small-scale irrigation in upper catchments. Approaches also extend to changes in crops, to reduce water demands or to respond to water scarcity, and modifications to allocations of water and energy among user sectors, to benefit domestic supplies and agriculture.

19. Attitudes also need to change to adopt the concept of the quality of water as a major determining factor in its value as a resource. Downstream riparians or users, while receiving an agreed allocation of water, may, owing to contamination, be unable to use it for purposes where some specific quality characteristics are needed - domestic supply, food processing and agriculture, for example. Alternatively, the restoration of suitable quality standards imposes costs and requires technical, management and legal measures. Such issues may, and do arise

at all levels, from the individual to that of Governments in internationally shared river basins. A further complication, and a potentially chronic problem, occurs when the exploitation and consequent degradation of water affects groundwater sources, where the restoration of quality may be at best long term and sometimes unsuccessful.

B. Water resources assessment

20. Resolution 1 and recommendation A of the Mar del Plata Action Plan stressed the need for greater knowledge about the quantity and quality of surface and groundwater resources, and for comprehensive monitoring to guide the management of those resources. The World Meteorological Organization has provided a real stimulus towards the fulfilment of that recommendation through support for national hydrological and meteorological services. So too have the International Hydrological Programme of UNESCO and the Global Environmental Monitoring System (GEMS) of UNEP in the assessment of world water balances and overall chemical loadings of waters. Closer to the management of national water resources, the Hydrological Multipurpose Subprogramme (HOMS), operated by WMO since the early 1980s, provides a channel for developing countries to acquire the technology necessary to maintain their water resources assessment activities. At the national level, however, progress has been less apparent. While in the late 1970s there was evidence that countries were responding to the call to develop and strengthen their water resources assessment programmes in line with the Mar del Plata Action Plan, the trend has reversed in recent years under pressure of economic stringency. The recent regional assessment of the situation gives cause for concern that, at a time when greater demands are being made for more precise information about the availability, variability, reliability and quality of water resources, data collection and analysis have fallen behind water development and management needs.

21. In Africa, in the early 1980s, there was an improvement in general large-scale water balance studies, water resources maps - including groundwater - and the statistical analysis of rainfall and stream flow. This modest increase has given way to a deterioration in equipment and its operation owing to a lack of funds and trained staff. The number of stations to measure precipitation and river flow remain well below those recommended, while the number of water quality stations is even lower despite the importance of these observations. Laboratory facilities to support water quality observations are lacking, and the situation is similar for measurements of sediment transport. Groundwater data collection networks are found mostly in areas of urgent water demand, such as large cities and irrigation schemes, but not all countries have appreciated the need for systematic monitoring of the resource. Although some countries have made progress in establishing national hydrological data banks using new computer methods, the effective dissemination to users is difficult. Hydrological research and development is lacking in most countries, and the basic training, development and retention of qualified water resources staff is acknowledged as a priority issue.

22. The evaluation of water resources assessment in the ESCWA region and North Africa is similar to that in sub-Sahara Africa. Two particular regional problems are those of intermittent flow in wadis and salt-water intrusion. The utilization

of intermittent flow for groundwater recharge offers one of the few remaining opportunities for surface water exploitation, but its assessment is an extremely difficult hydrological activity. The issue of fresh and salt water mixing in coastal aquifers already threatens existing developments. Meteorological networks appear to be in the most satisfactory conditions, and an improvement in hydrometric networks has been observed. However, a deterioration in operation and maintenance has also set in over this region. Database management procedures are at a very low level and, consequently, the availability of water data and information is generally unsatisfactory.

23. In the region covered by the Economic and Social Commission for Asia and the Pacific (ESCAP) good progress has been made in collecting project-oriented water data, in establishing computerized data banks and in preparing generalized water resources information. A main concern is the diversity of equipment used, and in their operation and maintenance. Problems of coordination exist, owing to the diversity of agencies, policies and programmes related to water resources assessment. Human resources training has been identified as a significant limitation in this region, reflecting the general lack of financial resources.

24. Overall coverage of hydrometeorological and surface water networks in the region covered by the Economic Commission for Latin America and the Caribbean (ECLAC) appears fairly well matched to development needs, but with little attempt at integration into a resource management system. Data collection is usually carried out on a project-specific basis, without any general plan, and this also reflects a diversity of agencies with interests and responsibilities related to water. Where there are national or international river basin authorities, their mandates, although often limited in scope, tend to include data collection, and consequently they give more systematic attention to assessment activities. Advanced technologies for data collection, transmission and analysis are a feature of the region. Groundwater, sediment measurement and water quality monitoring lag behind the other components, but have been initiated in most of the countries - usually in relation to urban centres and major schemes.

25. The practice of water resources assessment is most advanced in the region covered by the Economic Commission for Europe (ECE). With the exception of large parts of northern Canada and probably northern Scandinavia and the Union of Soviet Socialist Republics, which have only rudimentary systems in place, networks are comparatively well established and many different assessment and interpretative techniques, as well as modern hydrometric technology and database management techniques, are routinely applied. Within water resources assessment agencies, emphasis is being placed on the integration of policies, and some countries have recently overhauled their legislation. Human resources planning and development programmes have also been established in most countries. The issue of greatest concern, however, is the increasing pressure for the commercialization of water resources assessment activities arising from economic concerns, and preoccupation with environmental "hot spots". While forcing a renewed focus on clients and users, the potential exists for significant disruption of water resources assessment because the linkage between reliable data and effective decision-making is not clear to many managers.

26. From a global perspective, a serious concern exists regarding the ability of water resources assessment agencies to meet the growing needs for data and information. The issue of financial resources allocations is uppermost in the minds of all water resources assessment agencies, and recent budgetary cut-backs have taken their toll both in terms of operation and maintenance of networks and in the continued availability and reliability of information. A major cause of concern for the future lies in the obvious insufficiency of groundwater and water quality data even in some parts of the ECE region. A theme common to many countries is that of problems in training and retaining water resources assessment personnel, and up-dating their abilities to manage more advanced technologies and equipment. The fragmented nature of institutional arrangements is recognized as an impediment to the establishment of national integrated databases.

C. Drinking water supply and sanitation

27. The history, achievements, prospects and strategy for drinking water supply and sanitation are fully presented in the report of the Secretary-General on the achievements of the International Drinking Water Supply and Sanitation Decade 1981-1990 (A/45/327). The report predicts that expected high rates of population growth will continue to put severe pressure on the ability of developing countries to provide water supply and sanitation to the unserved. In the long run, it is to be hoped that policies in support of population and family planning will tend to alleviate such pressures. On the other hand, recent experiences of declining water availability, especially in semi-arid areas, pose another potential threat to closing this gap in services, which would affect women most severely as the main carriers of water, users, managers, protectors of family health and responsible for the members of their families and the community at large.

28. If drinking water supply and sanitation programmes were to continue at the current rate, the total number of those unserved with safe water by the year 2000 would decrease, because of increases in coverage in rural areas, in particular, but would still be about 770 million. Those unserved with sanitation would rise to about 1.8 billion. Such global figures, although bad in themselves, still obscure the desperate plight of the urban poor, without adequate water supply facilities, whose numbers would increase by 83 per cent, and those without adequate sanitation by 68 per cent. In relative terms, both Africa and the Asia/Pacific region would be worse off by the end of the century than they were at the start of the 1980s. The associated health and environmental consequences would preclude the attainment of living conditions compatible with sustainable development. Even where the existence of an infrastructure for water supply is cited as a criterion of "adequacy", there are many areas where that supply is irregular and unreliable owing to constraints on water availability, and of uncertain quality as a result of operational deficiencies. To achieve suitable coverage for 90 per cent of the urban and rural population of developing countries by the end of the century, it is estimated that the average annual level of investment required for new services would need to be about three times higher than the annual average achieved during the Decade.

29. Increases in demand for water in urban and rural areas, together with increases in demand for industrial and agricultural purposes, are taking place at a time when a greater number of countries are facing severe limitations in terms of the sustainable carrying capacity of land and water resources. Hence, policies designed to increase water supply and sanitation coverage to urban and rural areas will, more than ever, need to be integrated within balanced approaches to the overall management of water resources, taking into account the need to allocate scarce water resources to competing uses, as well as the need to protect the environment from rising levels of pollution from urban, industrial and agricultural uses.

D. Water for agriculture

30. During the past four decades, the development of irrigation has provided a major part of the agricultural production necessary to meet rising population demands. By the mid-1960s, 36 per cent of world crop production came from the 15 per cent of arable land under irrigation. Globally, the expansion of irrigation was about 1 per cent yearly in the 1960s, rising to a maximum of 2.3 per cent from 1972 to 1975, when it began to decline. Annual expansion is now less than 1 per cent. The reasons for this are many and varied, the most common being high development costs and less suitable land and water resources.

31. An earlier FAO projection of the growth of irrigated land was 2.25 per cent annually from 1982-1984 to the year 2000. Recent data show that this rate of expansion will not be achieved, and production increases must therefore come from the more intensive use of both rainfed and irrigated lands, together with soil and water conservation practices.

32. A high proportion of irrigation schemes perform at well below their planned production levels. Poor operation and maintenance and inefficient water management contribute to resulting socio-economic and environmental problems - a major one being that of rising groundwater, leading to waterlogging, depressed crop yields and soil salinity. This usually accompanies excessive and wasteful use of water. The current estimate of gross global irrigated land is 270 million hectares, of which 20-30 million ha are severely affected by salinity and a further 60-80 million ha to a lesser extent.

33. In many semi-arid and arid developing countries, the increasing demands for scarce fresh water, and priority for domestic, and sometimes industrial supplies, has necessitated the introduction of marginal water use for agriculture, including brackish water, drainage from irrigation and waste water. This calls for special attention because of the potential risks of salinization, dangers to human health and damage to the environment that may be associated with marginal water use - now an expanding area of agricultural water management.

34. Sustainability is the central issue in the FAO International Action Programme on Water and Sustainable Development, and it was against this background that five priority areas for action were selected. These are (a) water use efficiency, (b) waterlogging, salinity and drainage, (c) water quality management, (d) small-scale water programmes and (e) the management of scarce water resources.

1. Water use efficiency

35. Efficiencies in irrigation are determined by the suitability of the scheme and its management for conveying and delivering water to the crop. Defects in structures, operational procedures or application methods will be reflected in reduced efficiencies. An indication of the adequacy of irrigation systems is given by the responses from 16 Asian countries to a questionnaire from the FAO Regional Office for Asia and the Pacific, in 1986-1988, to investigate and analyse problems of large and medium projects. Common problems were identified as (a) inadequate planning and design, (b) deficiencies in on-farm irrigation and drainage facilities and (c) poor operation and maintenance.

36. There is now a common global trend towards scheme rehabilitation, upgrading and improvement of infrastructure, which promises to yield better returns than new developments, even if these are feasible. However, in some of the major irrigation countries, such as India and China, the widespread and large-scale use of flood irrigation, with low efficiencies, poor crop yields and degradation of soils, is a major technical and social challenge that must be tackled within overall state, province and national water management plans. In the Latin America and Caribbean region, low agricultural water use efficiencies are also common, and this is blamed basically on the economic crisis of the 1980s, which has resulted in a lack of farmer incentive, deteriorating markets and shortage of funds for the maintenance of existing scheme infrastructure. All this is evident in falling crop production and degraded land and water. The Western Asia region, where water scarcity is widespread, has found it necessary to aim for higher standards of water use efficiency. Where water conveyance is by canals, these are usually lined to reduce losses, and the conversion to piped networks is becoming more common, as in Jordan and Saudi Arabia, giving reported efficiencies of 90 to 95 per cent. There are, however, many older surface irrigation schemes in the region, giving far poorer results.

37. The efficient use of water is not only critical in formal irrigation schemes but also equally, if not more, important under rainfed and supplementary irrigated conditions. Large amounts of water and soil moisture are lost owing to improper management of rainfed farming. Land shaping to reduce runoff and maintaining crop residues on the surface to increase infiltration and soil moisture greatly enhance water use efficiency under rainfed farming conditions.

38. The current and potential roles of rainfed and irrigated agriculture need to be quantified taking into account the probabilities of rainfall, the available irrigation water supplies and their cost. With this information, resources can be invested proportionately to the probable benefits to be derived from both rainfed and irrigated agriculture.

2. Waterlogging, salinity and drainage

39. The greatest technical cause of decreasing production on many irrigated projects or failure of large irrigated areas is waterlogging and salinization of soils, especially in arid and semi-arid areas. Waterlogging is not an inevitable

result of irrigation. It is due to an excessive input of water into systems that have finite natural drainage capacities. Countries of many regions have problems of salinization owing to the inefficient use of water for agriculture. Argentina and Chile have about 35 per cent of their irrigated lands affected by salinity, whereas 30 per cent (250,000 ha) of the coastal region of Peru has the same problem. In Brazil, 40 per cent of the irrigated land is affected because of improper irrigation, and natural and man-induced salinity in Cuba extends to about 1.2 million ha. Argentina has more than 500,000 ha in need of drainage, while in Peru 60,000 ha in the coastal region and 150,000 ha in the upper catchment have drainage problems. The major irrigation countries of the Asia/Pacific region count the total area damaged by waterlogging and salinity in the tens of millions of hectares, and Western Asia is also facing severe problems of sustaining agriculture, arising from these causes. This is due to inadequate attention to drainage requirements at the time of project planning and design, compounded by high cropping intensities and low irrigation efficiencies. Since the early 1980s, many countries in various regions have carried out the rehabilitation and improvement of canal and drainage networks over millions of hectares.

3. Water quality management

40. From the point of view of sustainable agricultural development, water quality management has two major implications: (a) the quality of water used in agriculture should not cause crop damage and adversely affect agricultural yields; and (b) agricultural activities should not adversely affect the quality of surface and groundwater to such an extent that their subsequent use for other purposes has to be curtailed.

41. The use of marginal quality water has been a necessary development in the water-short countries of Western Asia and North Africa. Reuse of agricultural drainage water in Egypt already amounts to 3.4 billion cubic metres yearly, and up to 11 billion may be used in the future. Water from aquifers recharged with irrigation return flows is used for downstream areas in Yemen and Tunisia, and in coastal and island areas throughout the world the intrusion of sea water into both surface and groundwater sources, owing to over-exploitation, is calling for blending with higher quality water to permit continued irrigation. Where this is not possible, a change to crops of greater salt tolerance may be enforced.

42. Even in regions where water is not generally scarce, as for example Latin America and the Caribbean, the growth of urban development has placed heavy local demands on accessible sources and tended to reduce water qualities. The search for agricultural water has therefore led to the reuse of return flows and effluent - sometimes untreated - for irrigation, especially in the areas surrounding major cities. In Mexico, such supplies are estimated at 51 cubic metres per second, utilized on 165,000 ha.

43. A problem sometimes overlooked in relation to water quality management is that of sediment loads, which form a severe and widespread constraint in parts of the Africa, Asia and Latin America regions. This is basically a problem of upper catchment land management and conservation, involving large-scale economic and social interventions.

44. In many European countries, as well as in the United States of America and Canada, agricultural pollution, particularly contamination of groundwater with nitrates and pesticides, has called for a reduction in fertilizer and agrochemical applications in farms. Quite a number of surface water bodies in these countries are polluted by surface runoff from agricultural areas, resulting in eutrophication and significant reduction in aquatic life.

4. Small-scale water programmes

45. The issue of "scale", in terms of water projects, is rather subjective. In major irrigation countries, it may mean a few thousand hectares. Elsewhere, it is perhaps thought of as tens of hectares. It is in the latter form, but with probable aggregation to extensive areas, that it becomes most useful as a concept.

46. In the Sahelian countries of Africa, where there has been some disillusionment with large-scale irrigation because of high costs, long development periods and low returns, there has been a move to small-scale irrigated "perimeters", or even "micro-perimeters", within the framework of rural development. In Mali, for example, priority has been given to fully controlled water development through village-operated irrigation projects, following the identification of serious defects in large partial-control projects during recent exceptionally dry years. However, it is becoming apparent that small-scale irrigation is not necessarily an easy option. There is still a need for technical and management inputs, calling for trained personnel, particularly women, albeit at a lower professional level, and such people are not readily available. On the other hand, these skills are relatively common in the more traditional irrigation countries of Asia.

47. There is widespread applicability and importance in small-scale approaches to the development and conservation of upper catchment areas, particularly where these are subjected to population pressure, with deforestation or over-intensive cultivation. Experience on pilot watersheds in India, during the 1980s, has shown benefit-cost ratios of more than 3.0 resulting from conservation activities, which have improved groundwater recharge, filled small impoundments, protected the land from erosion and increased farmers' incomes. 7/

5. Scarce water resources management

48. Where resources are plentiful, they tend to be undervalued and mismanaged, which is the cause of many of the problems described earlier. Scarcity provides an incentive for improved levels of management, but it can also be a cause of inequity in distribution, where users, or potential users, have different degrees of advantage owing to finance, location, timing of their entry into the exploitation system etc. Therefore, whereas technology offers means of economy in water use, the attitudes and abilities of members of the community are often an overriding factor.

49. The preference of farmers for water-intensive crops, despite an adverse water balance overall, and mandated allocative arrangements and sanctions, is seen in the

cultivation of sugar cane in Maharashtra. This crop is favoured because it can be sold at a guaranteed price that is remunerative - net income per acre was two to nine times higher than that for other crops in the early 1980s. However, the popularity of sugar does not mean that its cultivation is socially preferable. Data show that this crop takes six to eight times as much water but generates much lower product value per unit of water than alternative crops. Estimates suggest that water currently utilized for sugar cane could, under different rotations and scenarios, greatly expand the area covered. 8/

50. Recent work by agronomists, soil and water specialists in the International Rice Research Institute (IRRI), and elsewhere, suggests that there is a need to review and perhaps revise concepts of high-yielding variety (HYV) rice as such a high water-demanding crop, and to view it rather as a water-tolerant plant that will give better results from a reduced and carefully regulated supply, together with more scientific fertilizer application. This could have profound effects on irrigation requirements in rice-growing countries, and thus on overall plans for water development and use.

51. Water must also be seen as a commodity, with an opportunity cost, not simply as an input to agricultural production. The fact that its value is not truly recognized in most irrigation schemes does not reduce its value for other uses. A reduction of allocation to irrigation may be attainable at a cost to agriculture, either by loss of production or through investment in higher technology and management, which is far less than the marginal cost of developing new supplies for domestic or industrial purposes. Similarly, an exchange of high quality water being used for irrigation, in return for adequate waste water, may be a sound principle of resource management.

E. Water quality

52. Most of the sources of pollution that have severely affected the industrialized countries are also present in the developing world, whereas measures for preventing or at least limiting the degradation of water quality, and even for the assessment of its scale and trends, are not generally applied. Furthermore, the ever-increasing population pressure and, more worrying, the rapid growth of urbanization are causing a dangerous concentration and acceleration of pollution and the deterioration of water quality in surface and groundwaters.

53. An assessment of the major water-pollution issues in the developing countries places them in the following order of severity:

1. Bacteriological pollution - mainly faecal contamination.

2. Organic wastes - domestic and agro-industrial waste water.

3. Suspended solids - mostly from soil erosion.

4. Organic micro-pollutants - agrochemicals/pesticides.

5. Nitrates - fertilizer into groundwater.

6. Eutrophication - nutrients into surface water.

7. Salinization - sea-water intrusion and irrigation.

54. In the Latin America region, one of the main causes of water pollution is the direct discharge of domestic sewage and industrial effluent into water courses. Of these two contaminant sources, domestic sewage is usually the more important, particularly in large population centres. It has been estimated that in Rio de Janeiro, Brazil, 70 per cent of the pollutants in the recipient waters around the city are of domestic wastes, while only 30 per cent are industrial and organic wastes from other sources. There is a lack of waste-water treatment plants for any but the most toxic industrial wastes. Virtually all municipal sewage and industrial effluent is discharged into the nearest rivers and streams without any treatment. In the future, demands on the water resources adjacent to metropolitan regions, for the disposal and transport of industrial and domestic wastes, are likely to increase owing to continued growth in population and industrial development. 9/ Another common source of pollution is agriculture, which, through irrigation, has given rise to high salinity affecting soils, surface waters and groundwater, and through the use of fertilizers and pesticides has caused the eutrophication of water bodies and levels of chemical residues dangerous to human life and aquatic biota.

55. The reports on both East and West Africa express very similar concerns, with emphasis on bacteriological content, organic waste loading, suspended solids and nitrates as major pollutants, and with the threat of increased problems from intensified agriculture and the associated expansion of fertilizer and pesticide use. A major cause of pesticide contamination is that of improper use, for which specific and practicable controls are needed, together with wider application of integrated pest control methods, placing less reliance on chemicals. Many of the shallow groundwater resources appear to be becoming contaminated by pathogenic agents, largely from domestic sources, but there is little systematic water quality monitoring to assess such trends in most of the countries studied.

56. The major aspect of water quality in the Western Asia region is that of salinity, associated closely with the large proportion of water used for irrigated agriculture, and thus the heavy demands mainly on groundwater sources. The lack of detailed information on water quality in this region appears to lie in a general absence of monitoring, which may be obscuring the presence of problems or trends towards their development.

57. The Asia and Pacific region presents problems similar to those of the other regions but, with its large and highly concentrated populations in the major countries, their scale is magnified accordingly. Sedimentation is proving damaging and costly to control in many river basins, arising from improper land management practices in upper catchments, where the pressure of growing populations exceeds the capacity of available, suitable agricultural land. Ultimately, this problem can be solved only through wide-ranging policies on population and natural resources, involving the people more actively in land use and soil management.

F. Water management and legislation

58. Physical, climatic and cultural differences impose a variety of regional and national constraints and conditions on policies for the development and management of water resources, but there are also many common factors.

59. Over the years, the tasks and concerns of public water management in the countries of the ECE region have been steadily expanding in response to the new requirements arising from socio-economic developments, increasing pressure on water resources and changing perceptions of their role and function. In the first two post-war decades, the aim was to satisfy, as far as possible, any demand for water and water-related services. Towards the end of the 1960s, water quality became an additional, if not main concern of water management, but it is only now that water management is being called upon expressly to ensure suitable conditions for water-dependent ecosystems. As the tasks and functions of water management expanded, the need for more comprehensive, coordinated policy approaches became evident. The concept of integrated water management had been developed to cover this need. It has now been accepted as a basic principle for policy guidance in all ECE member countries. Integration has to be a gradual process and, in practical terms, will differ from country to country, depending on traditional government structures and conceptual approaches to water management. 10/

60. ECLAC identifies the main problems in the management of water systems in Latin America and the Caribbean as: (a) the difficulty encountered in the operation and maintenance of constructed works and in the management and conservation of the natural resources in the project areas; (b) the excessive sectoralization of activities in the field of water; (c) the scant attention paid to social and environmental considerations generated by projects; (d) the difficulty in sustaining and giving priority to the large investments required for the utilization of water resources; and (e) the lack of attention to the use of water in the rainfed zones in the agricultural sector.

61. To solve these problems, various countries of the region have sought different options for the management, coordination and integration of activities associated with water resources, and during the past two decades a number have formulated national water plans for multi-purpose development and management. Therefore, on some fronts that foster the development of an adequate policy in the field of water utilization, as for example planning, management, integration, coordination among institutions, legislation and financial negotiation, important progress has been made in the region. Future progress will depend on more effective collaboration being established among the government agencies responsible for the development and conservation of water resources. 9/

62. A similar situation, regarding institutional frameworks, was revealed at a meeting on national master water plans in the Asia/Pacific region. This is well illustrated by the experience of Malaysia where, traditionally, water resources development and management were fragmented among various federal and state departments and agencies in accordance with their respective functions and activities related to water. In the absence of a comprehensive system to coordinate these activities, each sector tended to focus on its problems in

isolation. This led to duplication of activities and functions, and conflicts and competition occurred, leading to wastage in the use of resources.

63. In preparing the national master water plan, it was found that there was a need to have an infrastructural coordinating mechanism as well as a comprehensive national water code, if rational planning, financing and implementation of projects and programmes were to be achieved. Consequently, the final master plan included recommendations for the setting-up of administrative and institutional frameworks as well as the need for more comprehensive legal provisions. The need to incorporate sufficient flexibility in planning was underlined by the fact that events sometimes overtook the planning process, and proposals for water resources development had to be curtailed owing to rapid development or colonization of the catchment areas.

64. Many countries of the region have experienced shortcomings in planning and coordination, legislation, and the role of management, under severe constraints of human and financial resources. An ECA evaluation of the situation in Côte d'Ivoire, Morocco and Senegal found marked similarities in the efforts, achievements and problems encountered in the exploitation, development, operation and maintenance of their water-related activities. All have experienced difficulties in redefining and restructuring institutional arrangements for water development and management in their attempts to improve water supply, drainage and sanitation services. However, all can point to achievements in a greater knowledge of their water resources, better techniques in groundwater development and an increase in the number of water supplies. In addition, there has been more collaboration among the various institutions, agencies and parties involved in water resources management.

65. Measures proposed for overcoming these problems include the provision of adequate organizational and financial means for planning and management services; better interdepartmental collaboration; the early preparation of a water code to provide legislation in support of development; formulation of a tariff structure that will ensure the financing of water systems and protect the supplies to small users; and the participation of the private sector in operation and maintenance activities.

66. The river basin has been adopted as a framework for water activities, at the national level, in various countries of all regions, and is generally accepted as a means of stimulating interdepartmental collaboration in its objectives, which may range from a limited mandate to a fully integrated development plan. The Jordan Valley is a good example of the latter, initiated by the establishment of the Jordan Valley Commission in 1973. Since then, all successive development plans have achieved more than their stated objectives. The value of agricultural products rose from the equivalent of $US 20 million in 1973 to $180 million in 1987, and social gains have been outstanding in the fields of education, health and per capita income.

G. Shared water resources

67. The United Nations Water Conference was concerned that cooperative action should be taken to generate data on shared water resources, on which future management could be based, and to devise institutions and understandings for coordinated development. This concern reflects the widespread occurrence of shared river and lake basins, which account for about 60 per cent of the surface area of Africa and 65 per cent of the drainage area of Asian rivers. In Western Asia, 95 per cent of the average annual river discharge is from basins shared by two or more countries, while international basins account for 75 per cent of the total flow in South America. 11/

68. Since the Water Conference, the process of development and conservation of the resources of international river basins has been uneven. In a number of basins, cooperative work initiated earlier has continued. However, the paucity of financial, human and technological resources faced by many co-riparian countries has prevented significant new approaches and hampered development. This is particularly evident in the case of shared aquifers.

69. It is common for riparian countries to proceed with unilateral river development and, in some of the water-scarce regions, conflicting water demands among riparian countries are high and likely to grow. The Euphrates is an example of this, where the three riparian States, through unilateral river development works, have created greater regulation capacity than is required by the entire average annual flow, and yet, after more than 25 years, there is still no agreement on the sharing of water. In the case of the Nile, there is an urgent need to reach agreement on the development of the basin, because water is a key factor in the socio-economic development of the nine riparian States.

70. At the United Nations Interregional Meeting on River and Lake Basin Development in 1988, the important point was made that cooperative development must emerge from each participating State's clear recognition of international development as the best means of achieving national objectives. Such recognition cannot be achieved unless the States have the capability of assessing their own domestic strategies against the international alternatives. National planning institutions must then be capable of carrying out that assessment, and thus international assistance should be directed at strengthening the national planning effort. 12/

71. In the European region, where pollution of transboundary rivers and lakes is now a major problem, the Principles Regarding Cooperation in the Field of Transboundary Waters was adopted by the Economic Commission for Europe in 1987. The acceptance of these principles was followed by the adoption in 1990 of a Code of Conduct on Accidental Pollution of Transboundary Inland Waters. In addition, the elaboration of a convention on the protection and use of transboundary water courses and international lakes is currently under way.

III. A STRATEGY FOR THE 1990s

72. The areas for action identified by the Water Conference still provide a valid framework, but experience since 1977 has highlighted the following urgent issues now calling for priority within a national water strategy for the 1990s:

(a) Emphasis on the management of water as a finite resource, on the coordination and integration of water and land-use policies for sustainable development, and on overall planning for drought alleviation, water conservation in water-scarce areas and for mitigation of losses in flood-prone areas;

(b) For sound planning and management of water resources, particularly with the increasing stresses on the resources, systematic measurements and monitoring of surface and groundwater, along with the collection of water use data, have to be improved or, where necessary, instituted;

(c) For food production to be increased on a sustainable basis, a more efficient use of water is required for both rainfed and irrigated agriculture; better control of water logging and salinity is needed in irrigated areas; improvements are vital to the management of good and marginal quality waters; and the promotion of small-scale water projects and the optimization of the use of scarce water resources are necessary;

(d) To expand the coverage of drinking water supply and sanitation, special attention has to be given to rural and peri-urban populations, to the management of solid and liquid wastes, and to the environmental impacts of water supply and sanitation programmes;

(e) To enhance the capacity for the development and management of water-related programmes, greater efforts have to be made to strengthen institutions and develop human resources at all levels;

(f) To mobilize national and international resources available for technical cooperation and investment, and to increase the efficiency in the utilization of these resources;

(g) To promote the strategy and achieve its aims, awareness of the importance of water and of related issues needs to be highlighted through enhanced public information programmes.

A. Action at the national level

1. Water resources assessment

73. Government policies and plans must be based on comprehensive, reliable water data and information if sustainable water development is to be achieved. Institutional arrangements designed to enhance coordination and information transfer among water resources assessment agencies should enable maximum use of existing data, more effective deployment of stations and networks and collaboration

in producing vital information. It is recommended that Governments review existing institutional arrangements to evaluate their capabilities for meeting information requirements and ensuring the coordination of data-gathering activities in all water resources projects, as well as the appropriateness of legislative and regulatory provisions on water resources assessment. Particular attention should be given to the establishment of suitable linkages between information producers and users. Governments may also need to consider the necessity of preparing comprehensive catalogues of information held by various agencies, and establishing national water resources archives where existing archives are too fragmented. The importance of this type of work is increasing in view of possible climate changes and their probable consequences for water resources.

74. Evident deterioration in networks, their operation and maintenance, and information products must be arrested by increasing the awareness and appreciation of the economic value of basic water resources assessment, stressing the linkages between data, decisions and environmental health. The problem of allocation of sufficient financial resources to water resources assessment must be addressed if progress is to be made. To that end, it is necessary for the relevant agencies to define national requirements for data and estimate the economic and social value to be derived from them. There is a need for government agencies to explore novel ways of obtaining funding through such measures as fees for water monitoring permits and the recovery of costs for information provided to users.

75. The transfer and application of water resources assessment technology has been hindered by lack of equipment, techniques and training. However, the process can be enhanced through technology transfer systems such as the HOMS system referred to in paragraph 20 above. Emphasis should be placed on developing basic, user-friendly water resources assessment tools, and implementing these through enhanced training of public and private sector staff, at the national and regional levels. This applies to the use of standard monitoring techniques and equipment, as well as microcomputer-based analytical and information systems. New areal assessment procedures designed for practical application should be developed. There is a need for agencies to define their technology requirements with due consideration to staff capabilities and long-term sustainability, and to develop strategies to meet the shortfalls. Where it has not been done, personnel requirements should be assessed and appropriate targets developed with plans for training all levels of staff, making full and integrated use of existing education and training facilities. Attractive employment terms and career paths for professionals need to be provided where they are not adequate.

2. Drinking water supply and sanitation

76. To meet the challenges of the 1990s, the report of the Secretary-General on the achievements of the International Drinking Water Supply and Sanitation Decade 1981-1990 (A/45/327) made a number of recommendations concerning the need for strengthening institutional and human resources capacity within a framework of integrated water resources and environmental planning and management; improving efficiency in the distribution and utilization of water; assigning greater priority to the allocation of development financing and the generation of alternative

sources of funding; improving operation and maintenance and cost-recovery procedures; the use of low-cost appropriate technology; strengthening research and development programmes; community involvement and enhanced women's participation; and developing reliable procedures for monitoring service coverage as a tool for planning.

77. The New Delhi Statement, adopted at the Global Consultation on Safe Water and Sanitation for the 1990s, which was held in New Delhi from 10 to 14 September 1990, recommended that actions aimed at meeting the challenges be based on the following principles:

(a) Protection of the environment and safeguarding of health through the integrated management of water resources and liquid and solid wastes;

(b) Institutional reforms promoting an integrated approach and including changes in procedures, attitudes and behaviour, and the full participation of women at all levels of sector institutions;

(c) Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes;

(d) Sound financial practices, achieved through better management of existing assets, and widespread use of appropriate technologies. 13/

78. In resolution 45/181, the General Assembly endorsed the four guiding principles enunciated in the New Delhi Statement, and urged Governments, in their efforts to implement the recommendations contained in the report of the Secretary-General and in the New Delhi Statement, to stress the following important objectives:

(a) To assign greater priority to the allocation of development financing to water supply and sanitation by seeking a better integration of the sector within the overall development and planning process and to allocate a greater proportion of resources to low-income urban and rural areas, while addressing the deteriorating economic, social and environmental conditions in those areas;

(b) To implement programmes aimed at expanding service coverage within the framework of integrated water resources and environmental planning and management, in the context of sustainable national social and economic plans and urban and rural development policies, and to orient them towards services that reflect community needs and are used by beneficiaries;

(c) To ensure appropriate utilization of existing financial resources and mobilize additional funds from national Governments, donors and non-governmental organizations, and to draw on the resources of the local communities;

(d) To assess and undertake institutional reforms to promote an integrated approach, including changes in procedures, attitude and behaviour, and the full participation of women at all levels in sector institutions;

(e) To assess the current status of institutions, with a view to strengthening national capacities to plan and manage water supply and environmental sanitation programmes and to enable them to improve operational and financial efficiency;

(f) To increase their efforts to improve the efficiency and use of available financial resources by, inter alia, continuing to expand the use of cost-effective appropriate technologies, and to intensify South-South cooperation in that regard.

3. Water and sustainable agricultural development

79. Expansion of production in many developing countries during the 1990s will need to come primarily from increases in productivity from existing irrigated lands, and secondly, from rainfed lands. Urgent action is required to educate and train extension staff and farmers, strengthen water and soil management research under irrigated and rainfed conditions, monitor and evaluate irrigation project performance and establish effective demand management procedures and water-pricing policies. There is a need to develop national policies and programmes for the implementation of small-scale water projects for rural development. Special land and water management and conservation policies and programmes need to be developed and implemented in order to optimize water use under scarcity conditions. Appropriate legal frameworks to regulate water abstraction, monitoring and forecasting, and formulation of drought preparedness programmes are important to countries that frequently suffer from water shortages. Concerted and planned action is necessary to establish and operate functional and cost-effective monitoring systems, and to ensure that water available for agricultural use is of an acceptable quality. Simultaneously, appropriate steps must be taken to ensure that agricultural activities do not adversely affect water quality so that subsequent uses of water are impaired.

80. Countries with a long history of irrigation are already aware of the risks of salinization owing to excessive or badly applied water, and of the damage it can cause to land resources. Their national strategies will therefore provide a component to combat this threat to the sustainability of production potential. For those developing countries more recently embarking on irrigated agriculture, the incorporation of drainage facilities at the design and construction stages may prove to be a cost-effective investment. Where appropriate, irrigation development and expansion should also take into account the possibilities, including the necessary design and operational factors, for incorporating marginal quality water, from effluent or brackish sources, into existing and future scheme supplies. In the case of rainfed agriculture, surface drainage is required to prevent any temporary waterlogging and flooding of lowlands. In both cases, it is essential to minimize drainage requirements and costs by reducing the sources of excess water through improved system design and on-farm water management practices. The design of appropriate drainage systems, and the securing of funds for their construction and maintenance, as well as the safe disposal of drainage effluents, are important elements of a strategy for sustainable agricultural development.

81. To achieve the desired results outlined above, a number of supporting actions will need to be taken. These include the development of adequate databases, adaptive research programmes, the strengthening of institutions and of human resources development programmes, improved methodologies for socio-economic analysis, and measures for environmental protection and technology transfer.

4. Water quality

82. There are few parts of the world that are still exempt from problems of degraded water quality and the pollution of surface or groundwater sources. But the component that is currently overwhelming so many water management systems in developing countries is the discharge of domestic waste from urban centres. The growth of urban populations and the expansion of domestic and municipal water supplies have not been matched by a parallel service for effluent collection and treatment. The waste-assimilative capacity of fresh-water bodies adjacent to the towns has therefore been outstripped. In many major centres, the situation is now dramatic and dangerous, with its potential for damage to human health. There is also increasing concern about the entry of fertilizer and pesticides into surface water and groundwater. Despite these expanding and intensifying problems of water quality, the efforts to monitor them are minimal, and even the measurement of quantitative hydrological factors is described by many countries as "inadequate".

83. Actions designed to deal with water quality control and environmental considerations need to address the threefold objective of ecosystem maintenance, public health protection and sustainable water use. The formulation of policies and their implementation, aimed at the rational and sustainable development and management of limited water resources, must be based on the recognition of the interdependence between water quality and water quantity issues. The continuous depletion of groundwater, as well as its contamination with saline and toxic substances, is dramatizing the need to develop stringent policies and management plans for its sustainable use.

84. The efficient control of water quality must be based on scientifically sound data. Action is needed with regard to the establishment or strengthening of water quality monitoring systems, including the training of laboratory managers and technicians, the simultaneous monitoring of related environmental sectors and the integrated multi-media monitoring of aquatic ecosystems to ensure the availability of suitable information for integrated management. Concerning technical measures for pollution control, action needs to be taken with regard to measures aimed at the identification of pollutant sources and loads through rapid assessment procedures, effluent monitoring, investigation of industrial processes and verification of the use of agrochemicals, multi-media surveillance of potentially toxic chemicals and the adoption of pollution-control measures such as low-waste industrial techniques, recycling of wastes and product recovery. In addition, there is a need for the design and application of simplified and readily applicable methods to assess the environmental impact of proposed major development projects, the introduction of regulations to promote the rational use of agrochemicals, the establishment of intersectoral pollution-control programmes and the initiation of contingency plans at the national or regional level to control accidental spills.

85. The implementation of these measures requires, where it has not been done, the enactment of comprehensive legislation to cover all aspects of aquatic ecosystem protection and pollution source control, accompanied by the necessary provisions for their efficient enforcement. There is equally a need for the establishment of national coordination mechanisms for the generation of coherent databases and the development of technical skills to fulfil competently the variety of tasks involved. Economic and fiscal measures can be powerful tools for the control of pollution and the overexploitation of groundwater resources.

5. Water and related human resources management

86. The diversity of physical, economic and social circumstances cannot be encompassed in any single comprehensive model to determine future national water strategies, but there is increased recognition that new policies and programme approaches must be designed to reflect the relationships and interactions between human activities and water resources. The holistic management of water as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social objectives, is of paramount importance for action in the 1990s and beyond. However, the fragmentation of responsibilities for water resources development, among sectoral and administrative agencies, is proving to be an even greater impediment to attempts at integrated water management than had been anticipated.

87. While the balance between centralization and decentralization of power, and an adequate degree of flexibility, are matters for local adaptation, there has been a generally successful trend towards the designation of some national focal point, or centre, with responsibility for the management of water as a resource. Governments need to consider the necessity of establishing or strengthening such an institutional arrangement, including an appropriate form of national water resources centre with sufficiently strong executive powers in order to bring about an integrated approach to water management. The definition of an appropriate geographical framework for water management is another useful tool to assist in the implementation of multisectoral programmes, and more and more countries are adopting the river basin, catchment or watershed as the basic planning unit.

88. Recurrent droughts and declining water availability have demonstrated the need for attention to land and water management practices in the more arid regions. The concept of "drought-proofing", reflecting concern about possible climatic changes, is becoming an integral part of planning in countries such as India and China, where water conservation measures are encouraged, as are moves towards crop diversification and restricted water use for rice cultivation. Likewise, flood damage and associated disasters and measures for their control and mitigation are of great concern to many countries. The causes may be complex, but there are also strong linkages between land management in upper catchments and the intensity of flooding, and between land-use policies in flood-prone areas and the costs of damage or of its prevention. This places the subject clearly within many national water strategies.

89. The low efficiency of water use is a subject of concern to a majority of countries. This relates to all sectors, as it indicates excessive demands on the resource itself and on investment in infrastructure and operational costs. Because of the heavy water requirements of agriculture - particularly for irrigation - this sector represents, for many developing countries, a key to the rational overall use of water. Demand management, even if it gives only marginal savings of water, may have profound benefits when applied to agriculture, in the large volumes it releases for other uses, or in the costs avoided for additional resource exploitation.

90. Because of economic difficulties reported by so many developing countries, there is a common problem of maintaining water systems in a state that matches the design criteria and meets operational and efficiency requirements. This applies to all sectors, as there is seldom any accurate water auditing, and therefore little sense of accountability. Emphasis on rehabilitation of defective systems, reductions in wastage and unaccounted for water, recycling and reuse of waste water, and improved operation and maintenance can be more cost-effective than investment in new services. Increased attention needs to be given, and investment measures implemented, to improve water use efficiency and reduce wastage as well as damage to natural resources and the environment, with special reference to the maintenance and rehabilitation of infrastructures. The development and introduction of practicable measures towards scheme autonomy and cost recovery, in conjunction with greater efficiency and reliability to various sector users, needs to be given attention.

91. With the institutional and administrative changes that have been introduced to keep pace with water management, countries are discovering the need to adapt their legislation to match more dynamic and more demanding circumstances. Inadequate legislation has often been a serious impediment to water development or its optimal use. Of equal importance to the formulation of enabling legislation is the need to establish mechanisms to enforce its provisions. In many countries there is still an urgent need to evaluate the existing legislative framework with a view to redesigning legislation and the mechanisms for its effective implementation in order to meet present and future water management needs.

92. The provision of adequate human resources, with skills appropriate to the many scientific, technical, managerial and administrative functions required for the assessment, development, conservation and management of water resources, is implicit throughout the strategy proposals. The training of all levels of staff, from technicians to managers, is a strategic ingredient that must not be overlooked. Collaborative efforts to marshall local expertise and resources are recommended, along with the development of new curricula and materials in such areas as communications and management, in addition to technical fields. Since the Water Conference, there has been considerable attention to the development of those human resources, and experience shows that efforts must be continued. There is, however, a promising trend, in some countries, towards the more positive involvement of local communities in the conservation and management of their natural resources and the environment. This mobilization of the people, particularly women, with appropriate information support, and education and training programmes, may offer one of the greatest opportunities for the

sustainable management of those resources, and a campaign to stimulate such action could give a strong impetus to the implementation of a national strategy.

93. Overall, the insufficient availability of suitably trained personnel at all levels, as well as the inadequacy of career development programmes, together with the institutional weaknesses outlined above, continue to constitute two of the most, if not the most, serious constraints for the effective management and sustainable development of water resources. A pivotal element for a national strategy for the development and conservation of water resources in the 1990s and beyond is the creation of enabling planning and management frameworks capable of adapting to changing circumstances. This will permit the adoption of a well-coordinated holistic approach to the management of water resources in the light of present and future demands, taking fully into account the imperative of long-term environmental sustainability. It is recommended that Governments give the highest priority to undertaking assessments of the goals and objectives of their water resources agencies at the national and local levels, their organizational structures, personnel policies, and procedures for monitoring and accountability, with a view to bringing about a coordinated approach to water management. In doing so, it is also recommended that they evaluate the adequacy of their legislative framework as a tool for water management, and assess their human resources requirements in order to ensure the availability of suitably trained personnel.

B. International support

94. The elements of a strategy, outlined above, involve action with regard to two principal consumptive uses of water, namely, agricultural water use and drinking water supply and sanitation. They also involve action concerning various issues that cut across sectoral concerns, namely, water resources assessment, water quality and environmental control, and water resources management, together with related human resources development. Each of these elements warrants specific action at the national level, with related support at the regional and international levels by the organizations of the United Nations system, other international organizations, including regional and bilateral organizations and relevant non-governmental organizations.

95. Recently, for the purpose of stimulating action in community water supply, a network of external support agencies organized by the Collaborative Council for Water Supply and Sanitation has evolved through the activities carried out during the International Drinking Water Supply and Sanitation Decade. Linkages with all the organizations of the United Nations system are provided by the Steering Committee for Water Supply and Sanitation and by the ACC Intersecretariat Group for Water Resources. The Collaborative Council brings together the multilateral and bilateral agencies, regional banks, non-governmental organizations and members from developing countries. An International Action Programme on Water and Sustainable Agricultural Development, which proposes similar collaborative arrangements, has been formulated by FAO, in collaboration with other organizations of the United Nations system, through a working group of the ACC Intersecretariat Group for Water Resources, as a component of the strategy for the 1990s. Similar collaborative programmes for the organizations of the United Nations system are being formulated

in connection with water resources assessment and water quality and pollution control as part of the strategy for the 1990s and beyond.

96. To date, for the most part, the international community has typically followed a sectoral approach to the support of water use and development. The organizations of the United Nations system, as well as other organizations, have devoted considerable resources in support of programmes within the purview of the individual mandates of each organization. While a great deal of effort has been devoted to improving coordination and cooperation, the international community, as in the case of national authorities, has not provided sufficient support to the development and management of water as a finite resource, with a consequent neglect of the vitally important interdependence and interrelationships of subsector projects.

97. The subsequent failure to integrate economic, environmental and engineering aspects into water development, and manage the whole as a system, is probably the major reason for the limited achievements under the Mar del Plata Action Plan, especially in its long-term objectives. It is here that action must be taken if a "strategy for the 1990s" is to have any meaning, and the United Nations system of organizations can play a major catalytic role in bringing about international support for an integrated approach to water resources planning and management.

98. Consequently, in addition to the collaborative efforts mentioned above, the organizations of the United Nations system, through the Intersecretariat Group, are concentrating their efforts in developing concepts and approaches for integrating these various elements into a holistic approach to the management of water as a resource in the context of sustainable development, and with linkages to the attainment of socio-economic development objectives. As in the case of drinking water supply and water for sustainable agricultural development, efforts will be made to harmonize approaches with other multilateral, regional and bilateral organizations.

99. In terms of cooperation at the national level, the organizations of the United Nations system can play a significant role in assisting Governments, at their request, in carrying out interdisciplinary missions designed to undertake rapid assessments of their water resources situation, with a view to clarifying their policy objectives and formulating strategies for sustainable water resources development, evaluating institutional and human resources capacity requirements and creating an enabling framework for a renewed effort to identify priorities, build integrated policies and formulate cohesive programmes for accelerating water resources development.

Notes

1/ Report of the United Nations Water Conference, Mar del Plata, 14-25 March 1977 (United Nations publication, Sales No. E.77.II.A.12), chap. I.

2/ See report of the Secretary-General on the achievements of the International Drinking Water Supply and Sanitation Decade 1981-1990 (A/45/327).

Notes (continued)

3/ See report of the World Commission on Environment and Development, Our Common Future (Oxford, Oxford University Press, 1987).

4/ G. M. Higgins and others, "Trends in irrigation development and their implications for hydrologists and water resources engineers", Hydrological Sciences Journal, 33:1:2 (1988).

5/ P. E. Waggoner, ed., Climate Change and US Water Resources: Report of the Panel on Climate and Water of the American Association for the Advancement of Science (New York, John Wiley and Sons, 1990).

6/ M. Falkenmark and others, "Macro-scale water scarcity requires micro-scale approaches: aspects of vulnerability in semi-arid development", Natural Resources Forum, 13:1 (1989).

7/ R. B. Singh, "Sustainable development of rainfed agriculture through conservation cropping practices in the Asia/Pacific region" (Bangkok, FAO/RAPA, 1990).

8/ World Bank Resident Mission in India, "India: poverty, employment and social services" (Delhi, 1989).

9/ Economic Commission for Latin America and the Caribbean, "The water resources of Latin America and the Caribbean - planning, hazards and pollution" (Santiago, 1990).

10/ Economic Commission for Europe, "Water use and water pollution control: trends, policies, prospects" (ECE/ENVWA/10).

11/ Elements of an International Development Strategy for the 1990s (United Nations publication, Sales No. E.89.IV.3).

12/ River and Lake Basin Development, Natural Resources/Water Series No. 20 (United Nations publication, Sales No. E.90.II.A.10).

13/ Document A/C.2/45/3, annex.